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AS AD NO. 295106

THE INSTITUTE OF THEORETICAL ASTROPHYSICS  
UNIVERSITY OF OSLO

## SUPPLEMENT

for the period 15 July to 1 October 1962

to

## FINAL REPORT

for the period 15 April 1959 to 14 July 1962  
under Contract AF 61 (052) - 240

### "CONSTRUCTION AND OPERATION OF OSLO SPACE TRACK STATION"

by

HALLVARD ROSSELAND

The research reported in this document has been sponsored by The Geophysics  
Research Directorate, AFRL, through the European Office, Office of Aerospace  
Research, United States Air Force.

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OSLO, 25 October 1962

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## I. INTRODUCTION

The present report is a supplement to "FINAL REPORT for the period 15 April 1959 to 14 July 1962 under Contract AF 61(052)-240", and covers a stop-gap extension of the Contract from 15 July to 1 October 1962 pending the negotiation of a new contract for the continued optical precision tracking of artificial earth satellites at the Oslo Space Track Facility.

Under the terms of the contract The Institute of Theoretical Astrophysics observes satellite transits for which data have been supplied by the U.S. Air Force, using a Baker-Nunn Satellite Tracking Camera installed on the grounds of the Oslo Solar Observatory at Harestua. The reduced satellite time-position data are reported by teletype to the Space Track Research and Development Facility, Laurence G. Hanscom Field, Bedford, Mass.

## II. OBSERVATIONS

Observations, which were suspended on 15 May when the sky brightness made satellite photography impossible, were resumed on 4 August.

The cool, wet weather which ruled Norway during the entire summer continued into the fall, so that observations could be usefully performed on only 25 days in the period 4 Aug-30 Sep. Moreover, look angles were given for a very limited number of satellites. On some clear nights the crew had only one transit to observe. The total score for the period, therefore, was not very impressive.

Total number of attempted observations .....	42
No satellite on film .....	8
Interfering clouds or fog .....	4
Observer's error .....	0
Technical or film trouble .....	1
Moon interfering .....	0
Suspected errors in predictions .....	0
Elevation too small .....	0
Phototracks too faint for measurement .....	0
	13
	- 13
Number of passes measured and reported 4 Aug - 30 Sep 1962:	<u>29</u>

When the above figures are added to the totals reported in the FINAL REPORT, we get the following final results for the Contract:

Total number of attempted observations .....	1,172
No satellite on film .....	331
Interfering clouds or fog .....	88
Observer's error .....	13
Technical or film trouble .....	31
Moon interfering .....	7
Suspected errors in predictions .....	7
Elevation too small .....	2
Phototrack too faint for measurement .....	7
	486
	- 486
	686
Stellar background not identified	- 18
Number of passes measured and reported 13 Aug - 30 Sep 62:	<u>668</u>

### III. DARKROOM TESTS.

With the reduced observational load during the supplementary report period the staff turned its attention to a problem which has worried the project almost since the very beginning, viz. the high percentage of cases when the tracked object failed to show on the film.

All instruments and current procedures were checked against available instructions and operating manuals, and the entire operation was viewed as if the project were just about to start.

As the Baker-Nunn camera was in excellent focus, and the tracking procedure appeared to be water-tight, attention was turned to the darkroom processing of the films.

From the very beginning we have run the darkroom according to the book, confident that the instructions given to us by the local representative of Eastman Kodak for the processing of Special Royal-X Recording Film SO-283 and Spectroscopic I-D(2) were for optimum performance. Development time was given as 8-9 minutes in DK-50, diluted with an equal volume of water.

Standing instruction at the Oslo Space Track Facility is that manufacturers recommendations are not to be disregarded, except under unusual circumstances and in emergencies. When, toward the end of the supplementary report period, SPADATS gave advance warning of a shift in tracking priorities towards very small, high-flying objects, we decided that an emergency was indicated. Station Chief MELBY was given free hands to depart from manufacturer's instruction in the darkroom in order to see whether the camera's advertised ability to go down to the 15 magnitude could be proved on film. The earlier limit here had been about the 10 magnitude.

Encouraging results were obtained even in the first attempts, when the development time for Royal-X was increased to about 15 minutes. Detection was improved by several classes, and contrast increased noticeably without additional formation of fog.



#### IV. SPECIAL PROJECTS

The greatest delay factor in photographic satellite tracking is the long time required for processing of the film. At the Oslo facility the film has to spend an average of 90 minutes in the dark-room. For routine work this time lag is of less importance, but it becomes serious if one wants to obtain a fix on an orbiting object to establish the orbital parameters as soon as possible after launch. The lag is then of the order of one orbital period.

With the recent appearance of very high-speed instant films we feel it might be interesting to look into the possibility of their application in satellite photography, possibly in connection with the Baker-Munn camera.

Towards the end of the report period the staff was making tentative plans to adapt a Land camera loaded with high-speed Polaroid film to satellite tracking, and to run it at first in parallel with the Baker-Munn to obtain some idea of the usefulness of the technique.

# V. GOVERNMENT PROPERTY

As the present contract draws to a close it might be useful to give a brief survey of the property status at the Oslo Space Track Facility. In accordance with our avowed policy of running the station as cheaply as possible, very few non-expendable items have been purchased under the contract. The Government Property divides into Major and Minor Equipment. The Major Equipment subdivides into Locally Acquired and Government Furnished.

<u>Description of Items</u>		PURCHASE
MAJOR EQUIPMENT (LOCALLY ACQUIRED)	NO OF ITEMS	PRICE (US \$)
a. Camera Station ..... with accessory equipment	1	37,500.00
Specification:		
1. Camera room with sliding roof and outside track.		
2. Ladder to camera floor.		
3. Laboratory room.		
4. Photographic darkroom.		
5. Bedroom.		
6. Kitchenette.		
7. Toilet.		
8. Basement store room.		
9. Power line to Solar Tower.		
b. Double Wideroe Thermogarage .....	1	774.65
c. Hansen (Old Delft) Developing Machine HRW1-R2731 .....	1	597.10
d. Electrolux Refrigerator 107A .....	1	370.00
e. Madas Desk Calculator, Mod.20 BTG Special No. 94168, motor No. 116166 50/230V .....	1	1,172.54
MAJOR EQUIPMENT (GOVERNMENT FURNISHED)		
f. Baker-Nunn Satellite Tracking Camera Mark II Serial 2728 - 15 .....	1	108,500.00
g. Norrman Time-Frequency Standard Serial No. 124 .....	1	5,500.00
h. Power Unit for camera .....	1	2,652.00
		\$ 157,064.29

MINOR EQUIPMENT	NO OF ITEMS
1. Waste paper baskets .....	3
2. Plastic bottles for darkroom .....	4
3. Thermometer " " .....	1
4. Plastic funnels " " .....	2
5. Soldering iron .....	1
6. Tool set.....	1
7. Fan heaters .....	2

Each of the items listed above has been clearly marked with a rectangular black label with the following inscription in white letters:

INVENTORY No. x x x  
U S GOVERNMENT PROPERTY  
CONTRACT AF 61(052)-240

VI. PERSONNEL

No changes were made in the staff during the term of the Contract Supplement.

VII. TRAVEL

No travels were made under the contract.

VIII. PATENTS

No patents were applied for under the contract.

Oslo, 25 October 1962

Hallvard Rosseland